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RESEARCH ARTICLE

Soil quality and fertility in vineyards of Kilis province of Turkey, the northwest of "*fertile crescent*"

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ABSTRACT

This study was carried out in the vineyards in the Kilis province, where the cultivation of the "Horoz Karası" grape variety, which is also known as "Kilis Karası", occurs. In the study, 10 vineyards were sampled from the central villages of Kilis, Kocabeyli, Gülbaba, Çerçili, Hisar, and Saatli. Physical and chemical analyses were performed on the soil samples taken from these pre-identified vineyards, and the nutritional status of 50 vineyards was examined. In the vineyards included and analyzed in this study, it was determined that the soils were too calcareous between 15.18-45.46%, the pH was slightly alkaline with pH values between 7.2-8.2, the phosphorus content was generally low between 0.57-10.63 kg/da, the potassium content was between 35.12-145.40 kg/da, and the organic matter was found to be insufficient with values between 0.64-2.12%. It was also determined that the vineyards included in this study had a clay loam structure, and that the soils of our province were suitable for viticulture despite the limited nutrients in the soil. The grape producers of our province do not fertilize the vineyards, so they need to add the nutrients needed in the vineyards through fertilization by conducting soil analyses in order to determine which nutrients are lacking, so that the production of crops can continue efficiently.

Keywords: Kilis Karası; Nutrients; Physical and Chemical Properties of the Soil; Viticulture

INTRODUCTION

Viticulture started in our region with the beginning of the transition of people to settled life. The first civilizations established in Anatolia dealt with viticulture and agriculture, which formed the basis of their economies. For this reason, Anatolia is defined as both the homeland of the wild vine and the region where it was first cultivated. (Mc Govern, 2007). Important findings regarding the prehistoric periods related to viticulture were obtained from the archaeological excavations carried out in almost every region of our country. One of the most important reasons why viticulture first started in Anatolia and spread to the world is that these lands are located in the most favorable climate zone in the world for viticulture. Although Kilis Province, located in the Southeastern Anatolia Region, has the lowest surface area, with a size of 1.412 square kilometers in the region, it is understood that it is an important viticulture center among the provinces in both the region and our country. Kilis province has the 3rd largest vineyard area after Mardin and Gaziantep provinces with a total of 127.977 decares of vineyard area, and the 4th largest production area after Mardin, Gaziantep, and Adıyaman provinces with 51.685 tons of grape production, respectively. The "Kilis Karası" grape variety, which comes to mind with the viticulture in Kilis province, has superior quality features to compete with the world varieties. When the data for 2021 in our province was examined, it was reported that 18.143 tons of seeded raisins were produced in a total of 52.728 areas (Anonymous, 2021).

In many studies investigating soil fertility in vineyards, it has been determined that the soil nutrient content is not sufficient. It has been reported that in addition to some cultural measures to increase yield and quality in viticulture, soil fertility should be ensured (Çakmak et al., 1996). According to the results of the soil analysis of the producers, where the nutrient content of the vineyard soils of the Aegean region is insufficient, the yield has decreased; they should add the necessary nutrients by fertilization (Yağmur and Okur, 2018). In order to increase the yield and quality of grapes, it has been suggested to make the necessary fertilization at the beginning of the season and/or during the vegetation period of the vineyard soils that are deficient in terms of nutrients (Ateş, 2022). Yield and

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quality increase in viticulture can vary depending on the soil structure, the content of nutrients in the soil and (Kovancı and Atalay, 1977). Soil analysis is the most important method used to determine the physical, chemical properties of the soil and soil fertility as well as to determine the nutritional status of plants, for this purpose, the productivity level of vineyard soils should be examined (Çelik et al., 2017). As a result of the analyzes made on the soil samples taken from 15 vineyard areas; The amount of organic matter in 97%; It was determined that the amount of total N in 83% and the amount of available K in 21% was very low (Yıldız et al. 2022).

This variety, which contributes greatly to the economy of the region, is produced under inadequate nourishment and maintenance conditions in our province. As with all living things, the vine takes the nutrients necessary for its survival, development, and yield from the soil, together with water, in raw form. Since the nutrients available in the soil will gradually decrease over the years, if it is not added with fertilizer, the development slows down and the yield decreases (Çalık, 2020). The main purpose of agriculture is to obtain abundant and quality products. For this reason, it is necessary to add the nutrients lacking in the soil to ensure good development in the vineyards and to obtain sufficient products (Calik, 2021).

In Kilis province, viticulture is carried out by traditional methods. Production is carried out without fertilization. There is a bias among farmers that fertilizers will harm the crop. While some of the farmers apply barn manure, some of the farmers do not apply this organic fertilizer because it causes weeds to grow and spread. For this reason, it is seen that the yield decreases from year to year in the vineyards. To date, no detailed study has been conducted on the nutrient content of the vineyard soils found in the Kilis province.

In this study, the vineyard soils of Kilis province, located in the north-western corner of the "*Fertile Crescent*" region, where the ruins of the Neolithic period were found in the Akpınar, Çörten, and Yeşilyurt Mounds, and where six of the eight fundamental plants, which are the basis of agriculture in the whole world and accepted to be domesticated for the first time in history, were examined. In this study, the soil samples were taken from the villages where viticulture is intensively performed in Kilis and subjected to a detailed analysis. With this study, the physical and chemical contents as well as the fertility status of the soil were evaluated in the vineyard areas of our province. The reason for the decrease in yield experienced from year to year in the vineyards, which have an important production area in our province's agriculture and contribute greatly to the economy, has been investigated. The aim of this study is to reveal the nutritional status and some important soil characteristics of Horoz Karası vineyard soils in Kilis province.

MATERIALS AND METHODS

Materials

There is a warm and temperate climate in the Kilis province. In the winter months, much more rain falls as compared to the summer months. The annual average temperature of Kilis Province is 16.8 °C. The average annual rainfall is 377 mm, and July is the driest month of the year, with only 1 mm of rainfall. With an average rainfall of 72 mm, the highest precipitation is observed in December. With a temperature of 28.5 °C, July is the hottest month of the year. The average temperature in January is 5.0 °C and it is the lowest average of the year. In July, the highest number of aprication (exposure to sunlight) hours per day is measured on average in Kilis. It receives an average of 12.53 hours of sunlight per day in July and a total of 388.51 hours of sunlight during July. (Anonymous, 2022).

The research was carried out in the vineyard areas in Kocabeyli, Gülbaba, Çerçili, Hisar, and Saatli, which are the central villages where the viticulture of Kilis province is intensively carried out. In order to represent Kilis vineyard areas, 10 soil samples were taken from each village in 2018-2019, and soil sampling was performed from a total of 50 vineyards. In these soil samples, physical and chemical analyses were performed in the laboratory, and the study attempted to determine the efficiency status of these vineyards.

Methods

In this study, pH, lime, texture, salt, organic matter, phosphorus and potassium contents were determined in order to determine fertility of vineyard soils of Kilis province. For this purpose, soil analyzes of the following methods were carried out in the samples taken. In each vineyard, a soil sample was taken from 10 points by zigzagging from a depth of 0-50 cm according to the soil sampling method, and a 1 kg soil sample was brought to the laboratory after blending (Kacar, 1994), (Hillel, 1982). The sample was prepared for analysis by drying it in the soil laboratory and passing it through a 2 mm sieve (Chapman and Pratt, 1961). In the soil samples taken, the structure was brought to saturation by adding pure water to the soil, and then the soil structure was determined. The soil reaction was measured with a pH meter with the saturation sludge, and the total amount of fusible salt from the saturation sludge was calculated using the Scheibler calcimeter according to the EC meter (Richards, 1954), (Tüzüner, 1990), and as per the total lime amount

Table 1: Distribution of Grape Production in Southeastern Anatolia Region by Provinces in 2021

	Table Grapes with Seeds		Seedless Table Grape		Dried Grapes with Seeds		Seedless Dry Grape		Grape for Making Cider	
	Area (Decare)	Manufacturing (Ton)	Area (Decare)	Manufacturing (Ton)	Area (Decare)	Manufacturing (Ton)	Area (Decare)	Manufacturing (Ton)	Area (Decare)	Manufacturing (Ton)
Adıyaman	74 070	45 219	269	85	32 010	21 037		0	100	43
Batman	39 498	14 460	100	36	19 038	6 583	250	90		0
Diyarbakır	145 125	83 191	0	0	12 710	8 092		0	13 840	9 444
Gaziantep	101 818	82 692	4 000	4 968	48 277	32 318		0	9 535	6 251
Kilis	3 842	1 588	0	0	52 728	18 143		0	71 407	31 954
Mardin	177 906	86 929	0	0	133 414	57 859		0	52 435	20 422
Siirt	23 002	11 824	0	0		0		0		0
Şanlıurfa	8 708	3 366	0	0	1 717	690		0	30	11
Şırnak	28 899	11 769	0	0	1 449	906	132	11		0

TUIK, 2021.

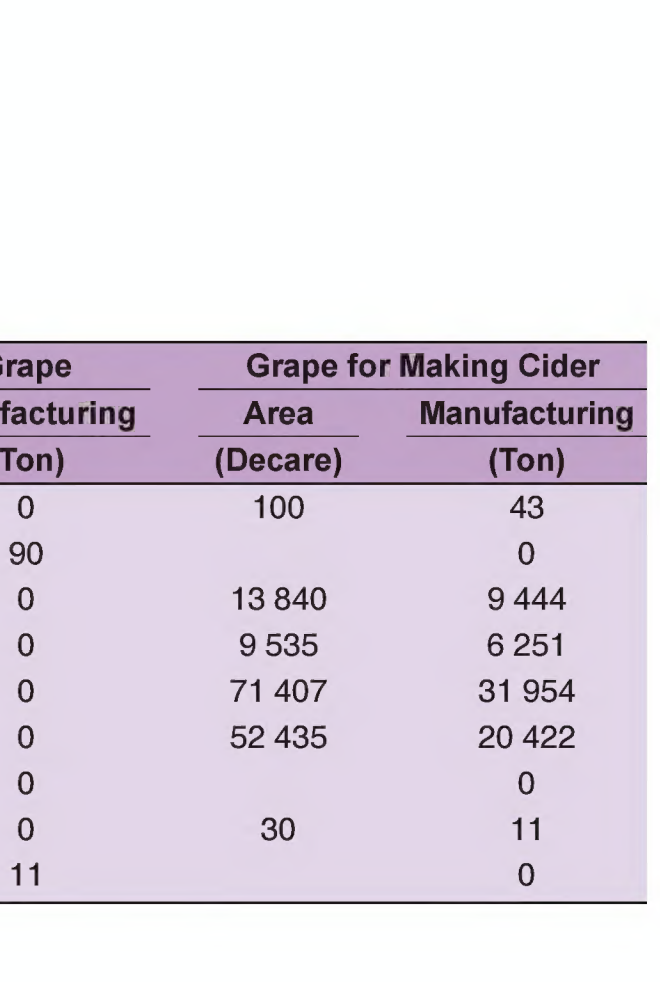

Fig 1. Horoz karası grape variety harvest.

(Allison and Moodie, 1965). Organic matter (Walkley and Black, 1934), removable phosphorus (Olsen et al., 1965), and the amount of potassium were determined by reading the values on the Flamefotometer according to (Tüzüner, 1990). The results of the analysis obtained in this study, the inadequacies, and excesses in the physical and chemical contents of the soils were evaluated according to (Ülgen and Yurtsever, 1995), (Table 2). The study area map is given in Fig. 2 and soil sampling points are given in Fig. 3.

Statistical analyses

The soil samples taken from different villages were evaluated with the Tarist statistical software and the differences between the averages of different villages were evaluated with the Duncan multiple comparison test (Açıkgöz, 1993) at the $p<0.01$ significance level.

RESULTS AND DISCUSSION

In the study, the data on the physical and chemical properties of the soils taken from the vineyard areas where the "Horoz Karası" variety is grown are presented in Table 3. In the study, the soil properties and nutrient content of the vineyards in Kocabeyli, Gülbaba, Çerçili, Hisar, and Saatli villages were determined. In the vineyards included in the study, the age of vine was between 15 and 65, the soils were very calcareous between 15.18% and 45.46%, the pH was between 7.2-8.2, and it was determined that it was at a mild alkaline level in general. Although the affordable phosphorus content of the soils varies between 0.57-10.63 kg/da, it has been determined that it is generally low, the potassium content is sufficient between 35.12- 145.40 kg/da, and the organic matter is considered as insufficient with values between 0.64-2.12%. It has been determined that the vineyard soils have a clay-mixed loamy structure.

When the results obtained were evaluated, Hisar1 and Hisar were detected with the lowest pH value of 7.2 in

Table 2: Limit Values Used in Soil Productivity

Soil analyzes	Limit Values and Evaluation					
pH	< 4.5 Strong acid	If 4.5-5.5, Medium Acid	Mild Acid if 5.5-6.5	Neutral if 6.5-7.5	Light Alkaline if 7.5-8.5	Strong Alkaline if > 8.5
Lime	If 0-1, it is less calcareous	If 1-5, it is lime	Medium Calcareous if 5-15	If 15-25, Too Calcareous	If > 25 Too Lime	
Texture (% Saturation)	Sand if 0-30	If 30-50, Tın	If 50-70, Clay Tın	If 70-110, Clay	Heavy Clay if > 110	
Salt	If 0-0.15, unsalted	If 0.15-0.35, it is slightly salty	Medium Salted if 0.35-0.65	If > 0.65, Very Salty		
Organic matter	Very little if 0-1	If 1-2, it is less than	Medium if 2-3	Good if 3-4	High if > 4	
Phosphorus (kg/da)	If < 3, very little	If 3-6, it is less than	Medium if 6-9	High if 9-12	>12 Very High	
Potassium (kg/da)	Less than < 20	Medium if 20-30	Sufficient if 30-40	Excess if > 40		

Ülgen and Yurtsever (1995).

Fig 2. Map of the province of kilis.

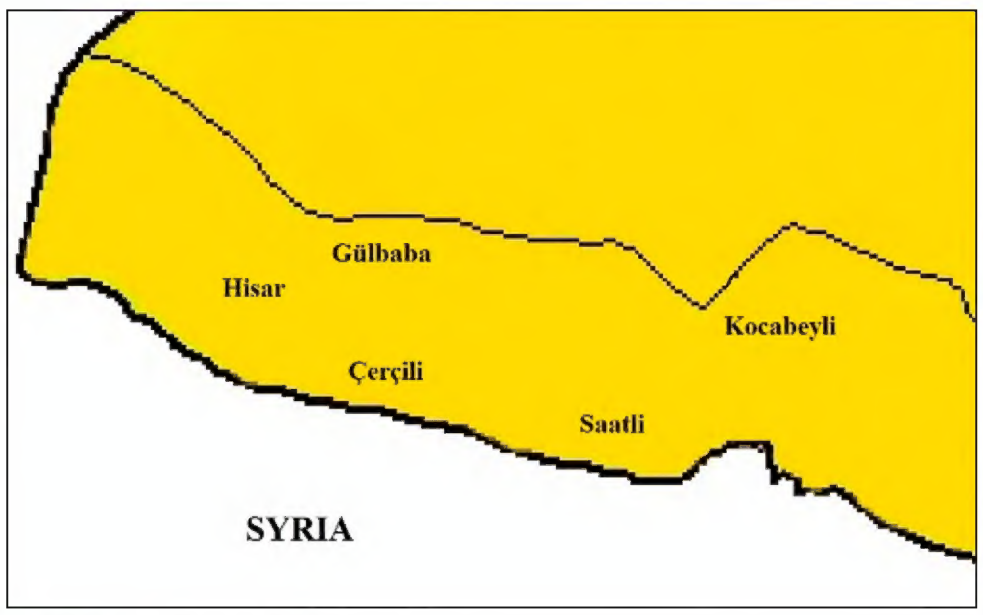

Fig 3. Map of sampling area.

vineyard no. 9, and the highest pH was detected in the soil of Saatli 5 and Kocabeyli 7 with a value of 8.1. While soil reaction produces positive results with the variable Ca content of the soil, it has antagonistic relationships with the useful Mn, Fe, P, and Zn mineral content of the soil (Doran et al., 2008), (Eyüpoğlu, 1999). (Çelik, 1998), and some other researchers reported that the pH values of vineyard soils were between 5.5 and 8.5. In terms of viticulture, it has been reported that the ideal soil pH is in the range of 6.7-7.7, and neutral soils are the most suitable soils (Leake, 1999).

Among the soils in the study, the pHs of Ko3, Ko5, Ko7, and Ko8 in Kocabeyli village, Gü2, Gü3, and Gü6 in Gülbaba village, and Sa3 and Sa4 in Saatli village were found to be higher than the 7.7 limit value. When evaluated in general, it was determined that the pH of Kilis province vineyard soils had suitable reaction conditions for viticulture.

It was determined that the vineyard soils in the study had clay and loamy texture (Table 3). It has been reported that ideal vineyard soils have a loamy texture, contain less than 5% stones and gravel, and that deep (>75 cm) soils with a structure ranging from clay loam (CL) to light clay have high yield potential in viticulture (Kurtural, 2011). Loamy soils are suitable for viticulture. They become ready and warm up quickly. It is deep and has a high water holding capacity. High-quality table and wine grape varieties can be grown in rich soils. The fact that the soil sometimes contains small stones ensures that the soil heats up quickly. Loamy soils have been reported to be suitable for quality grape growing due to all these favorable properties (Gücüyen, 2007). According to the limit values given in Table 2, it was determined that they have the ideal texture for viticulture.

The salt content of the Kilis province vineyard soils was between 0.0068% and 0.0612%, and it was determined as unsalted according to the limit values determined by (Ülgen and Yurtsever, 1995). Vine is an abstemious plant that can grow in lands where many cultivated crops cannot grow. However, it has been reported that viticulture is not appropriate in soils with a very heavy structure, impermeable, salty, and toxic substances (Gücüyen, 2007). When the examined villages were evaluated, a significant difference was determined at the level of $p<0.01$ in terms of salt content in the vineyard lands in 5 different villages. While the vineyard lands of Hisar village were classified as slightly salty with 0.1720%, the vineyards in Kocabeyli, Gülbaba, Çerçili, and Saatli villages were determined as unsalted. In terms of salt, generally, the examined vineyards

Table 3: Physical and Chemical Analysis of the Soils in the Vineyard Areas of the Kilis Province

Soil sample No	Age	pH	Texture (%Saturation)	Salt	Lime	Organic matter	Phosphorus (kg/da)	Potassium (kg/da)
Ko1	24	7.3	56	0.0124	16.12	1.56	0.92	66.10
Ko2	25	7.5	63	0.0216	18.22	1.12	1.18	36.18
Ko3	60	7.9	66	0.0156	45.14	2.00	4.81	135.20
Ko4	17	7.5	54	0.0512	15.12	1.84	1.83	50.64
Ko5	22	7.8	47	0.0214	42.11	1.71	7.56	55.89
Ko6	55	7.4	72	0.0231	18.47	1.12	3.21	62.41
Ko7	60	8.1	63	0.0148	17.56	1.76	5.54	89.45
Ko8	62	7.9	56	0.0112	42.13	1.58	1.81	86.10
Ko9	58	7.4	56	0.0162	45.02	0.98	1.69	74.02
Ko10	15	7.3	44	0.0085	22.18	0.94	10.09	102.26
GU1	21	7.6	70	0.0131	26.10	0.78	1.56	125.65
Gu2	34	7.8	46	0.0162	18.45	0.95	1.86	140.12
Gu3	56	7.8	62	0.0204	32.12	1.12	2.12	112.17
GÜ4	61	7.7	60	0.0285	30.60	1.14	3.21	85.56
GÜ5	48	7.5	58	0.0112	18.74	1.16	3.64	80.20
Gu6	34	7.9	73	0.0068	22.96	1.19	6.12	75.32
Gu7	26	7.3	65	0.0095	42.55	1.95	4.16	51.38
Gu8	45	7.4	66	0.0146	45.23	2.10	8.24	36.25
Gu9	26	7.3	72	0.0472	15:08	2.12	7.52	40.30
Gü10	32	7.4	74	0.0612	24.30	0.78	1.56	64.40
Çe1	18	7.6	78	0.0093	15.18	0.56	0.54	132.80
Çe2	16	7.2	66	0.0127	18.58	0.64	1.87	145.40
Çe3	22	7.4	56	0.0154	26.25	0.74	1.18	136.50
Çe4	45	7.3	48	0.0179	34/36	0.72	1.92	40.55
Çe5	50	7.3	59	0.0068	38-42	0.79	2.47	35.70
Çe6	52	7.4	46	0.0174	38.12	0.89	2.76	35.95
Çe7	58	7.8	56	0.0341	40.25	0.92	2.98	42.13
Çe8	64	7.7	61	0.0125	40.12	1.12	3.45	76.20
Çe9	61	7.9	68	0.0146	45. 46	1.16	4.12	82.52
Çe10	16	7.8	75	0.0089	45.40	1.42	4.11	36.40
Hi1	62	7.2	76	0.0143	37.16	1.15	1.79	126.20
Hi2	62	7.4	78	0.0281	39.25	1.31	2.45	130.10
Hi3	50	7.4	68	0.0319	28.52	1.78	2.75	141.56
Hi4	19	7.6	64	0.0097	34.50	2.02	10.63	95.75
Hi5	19	7.4	67	0.0142	30.56	1.89	3.85	127.34
Hi6	27	7.4	56	0.0279	35.45	1.14	2.27	105.70
Hi7	34	7.7	55	0.0078	24.20	1.10	1.12	116.50
Hi8	46	7.5	55	0.0124	25.10	0.78	0.98	122.48
Hi9	48	7.2	62	0.0130	26.18	0.64	0.77	98.45
Hi10	40	7.3	63	0.0128	40.10	0.74	0.65	75.90
Sa1	25	7.3	60	0.0097	42.25	0.66	1.15	46.12
Sa2	27	7.6	60	0.0127	45.20	0.59	2.59	102.56
Sa3	32	7.9	74	0.0123	38.25	0.78	2.48	55.80
Sa4	39	7.9	77	0.0137	36.12	1.95	3.16.	64.10
Sa5	40	8.1	64	0.0122	16.10	1.86	4.22	100.22
Sa6	45	7.6	66	0.0119	19.24	1.45	2.85	38.45
Sa7	56	7.5	63	0.0121	22.27	1.64	1.17	79.28
Sa8	60	7.5	63	0.0182	28.65	1.23	1.65	82.34
Sa9	60	7.4	71	0.0113	38.13	0.77	2.89	68.57
Sa10	18	7.6	56	0.0114	40.60	0.81	6.55	85.13

were found to be salt-free and suitable for viticulture (Table 4).

When the vineyard soils were examined in terms of the organic matter content, it was determined that the vineyard soil number Gü2 had the highest organic matter content with 2.12%, and the vineyard soils in samples Hi9 and Çe5 had the lowest organic matter content with 0.64% (Table 3). In agricultural areas, especially if the organic matter content is low and the lime content is high, inorganic

Table 4: The Average Values of Vineyard Soils in the Kilis Province

Village Name Of the Sample	Age of the Vineyard	pH	Texture (%Saturation)	Salt	Lime	Organic matter	Phosphorus (kg/da)	Potassium (kg/da)
Kocabeyli	39.8^{ns}	7.61^{ns}	57.7^{ns}	0.0209^{b*}	28.20^{b*}	1.46^{a*}	3.86^{b*}	75.82^{b*}
Gülbaba	38.3	7.57	64.6	0.0257^{b}	27.61^{b}	1.44^{a}	4.16^{a}	81.13^{b}
Çerçili	40.2	7.54	61.3	0.0149^{c}	30.18^{a}	0.89^{c}	2.54^{c}	76.41^{b}
Hisar	40.7	7.41	64.4	0.1720^{a}	32.10^{a}	1.25^{b}	2.72^{c}	113.99^{a}
Saatli	40.2	7.64	65.4	0.0125^{c}	32.68^{a}	1.17^{b}	2.87^{c}	72.25^{b}
Average	39.84	7.55	62.68	0.0492	30.15	1.24	3.23	83.92

ns: Insignificant
*Differences between villages are significant at the level of p≤0.01.

fertilization and irrigation do not make the intake of plant nutrients difficult according to (Bozkaya, 2009). In terms of organic matter content, sandy soils are poor soils with low nutritional value. These soils heat up quickly, and plant vegetation starts early, so ripening also occurs early (Gücüyen, 2007). According to the results of the research, it was reported that the organic matter content of the vineyard soils was between 2-3% (Kurtural, 2011). While a positive relationship was observed between the organic matter content of the soil and the useful phosphorus, iron, manganese, and zinc content, its relationship with the lime content was negative. The organic matter content of Kilis provincial vineyards was determined to be very low. The lack of organic matter is due to the fact that producers do not apply fertilizer. The organic matter content of 85% of our country's lands is less than 1% (Bellitürk et al., 2019). According to the soil analysis results obtained in the Laboratory of the Pistachio Research Station, 63% of the soils in the Southeastern Anatolia Region were found to contain less than 2% organic matter. Organic matter content is the most important factor affecting the fertility of soils. Organic substances contribute positively to the physical, chemical, and biological properties of the soil and increase the product yield (Arpacı and Tekin, 2001). Organic fertilizers have been reported to increase soil organic matter content, increase crop yield in vineyards, and improve the physical properties of the soil (Kuzucu, 2019), (Çalık, 2021). 5 different village vineyard areas were found to be statistically significant ($p<0.01$) in terms of organic matter content. While the organic matter content of Çerçili village vineyards was very low, Kocabeyli, Hisar, Gülbaba, and Saatli vineyards were found to be lower in terms of organic matter. The bonds examined in this study generally contain 1.24% organic matter (Table 4)

While the soils examined in the study were generally classified as too calcareous in terms of lime content, the soils belonging to Ko9, Gü8, Çe6, and Çe7 vineyards were 45% and above, and they were included in many calcareous groups (Table 3). While the high amount of lime in the soil prevents the intake of some nutrients, and especially in iron deficiency, there are signs of nutrient deficiency called chlorosis caused by lime (Çelik, 1998). In addition, in the absence of iron caused by high lime-containing soil conditions, it has been reported that the iron compounds applied to the soil generally become unacceptable, and that iron chelates should be used to correct this situation. It has been reported that the vineyards are mostly deficient in N, P, and Zn elements, the pH ratio of the soils is generally high, and the lime content is moderately high. Therefore, it is known that the high lime content of the soils prevents the uptake of other nutrients, especially P and Zn, which are important for plant nutrition (Tüfenkci et al., 2009; Çelik et al., 2017).

In this study, high lime content negatively affected the amount of phosphorus that could be taken ($R^2=0.81$). As the lime content of the soil increased, the phosphorus content decreased. A linear relationship was obtained in this regard (Fig. 4). The % of lime content of vineyard soils was found to be statistically significant at a $p<0.01$ level on the basis of villages. The average lime content of the villages was 30.15% and has been evaluated as very calcareous (Table 4). The % of lime content organic matter regression analysis in Çerçili village was found to be $R^2=0.70$. It was determined that as the lime content increased, the organic matter content of the soils linearly decreased (Fig. 5). However, at some sampling points in the same village, high lime did not affect the organic matter content.

The phosphorus nutrient element plays a major role in the vegetative development and growth of the plant, especially in generative organs such as flowers, seeds, and fruits, and increases flowering and fruit ripening (Kacar and Katkat, 1999). It has been reported that the useful phosphorus content is deficient if it is less than 25 mg/kg, marginal if it is between 25-35 mg/kg, sufficient if it is between 35-80 mg/kg, and considered to have high P content if it is more than 80 mg/kg (Lanyon et al., 2004). While the phosphorus content of the soils in the vineyard areas of Kilis province is generally classified in the low-level category, it has been detected in the Hi4 and Ko10 vineyard soils at levels of 10 kg/da and above, and with that amount it can be considered in the high-level category. (Table 3).

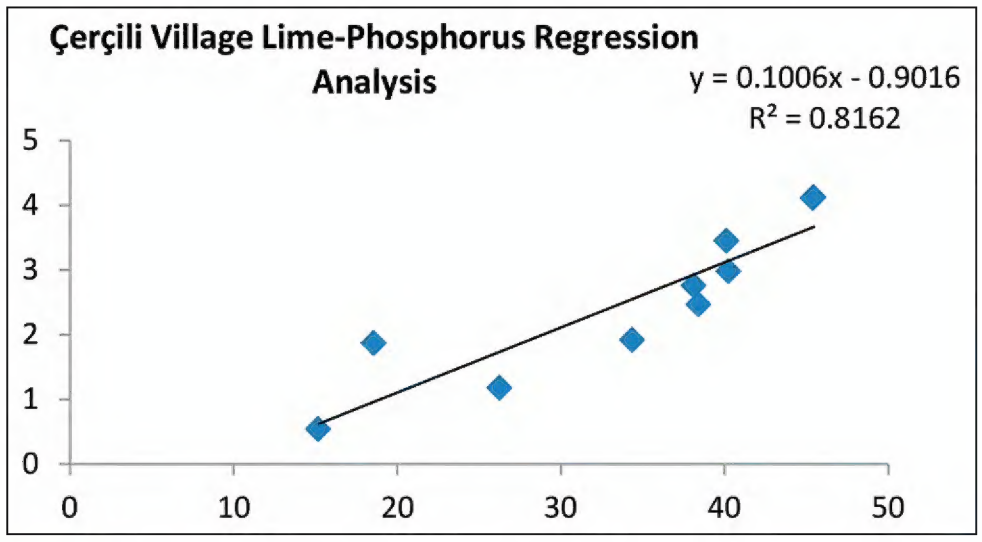

Fig 4. Lime-phosphorus regression analysis.

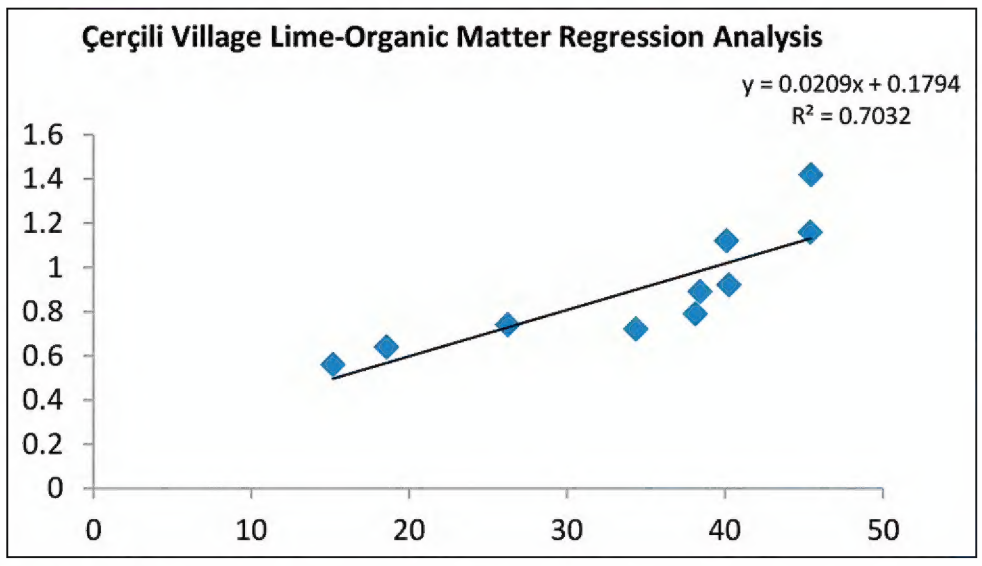

Fig 5. Lime-organic matter regression analysis.

It has been reported that the usefulness of phosphorus is limited in these agricultural soils in the Southeastern Anatolia region due to their high lime content, alkalinity, and being poor in their organic matter levels (Eyüpoğlu, 1999). The average phosphorus content of the vineyards examined in the study was found to be statistically different. While the P content of Kocabeyli and Gülbaba villages was low, the phosphorus content of Çerçili, Hisar, and Saatli villages was found to be very low. When the village averages were evaluated, Kilis province vineyard soils with 3.53 kg/da P content were found to be less and insufficient in terms of P as compared to the results found in (Ülgen and Yurtsever, 1995) (Table 4).

A linear relationship was found between the organic matter content of Gülbaba village and the phosphorus content. As the amount of organic matter increased, a positive increase was observed in the removable P content of the soil (R2=0.68). In the same village, it was determined that the organic matter content had no effect on the phosphorus content (Fig.6).

In viticulture, K nutrient quality characteristics are very important for the market value. It is the nutrient that increases the shelf life, aroma, taste, and sugar ratio of grapes, as well as their value. The lands of our country are potassium-rich lands. The potassium content of Kilis

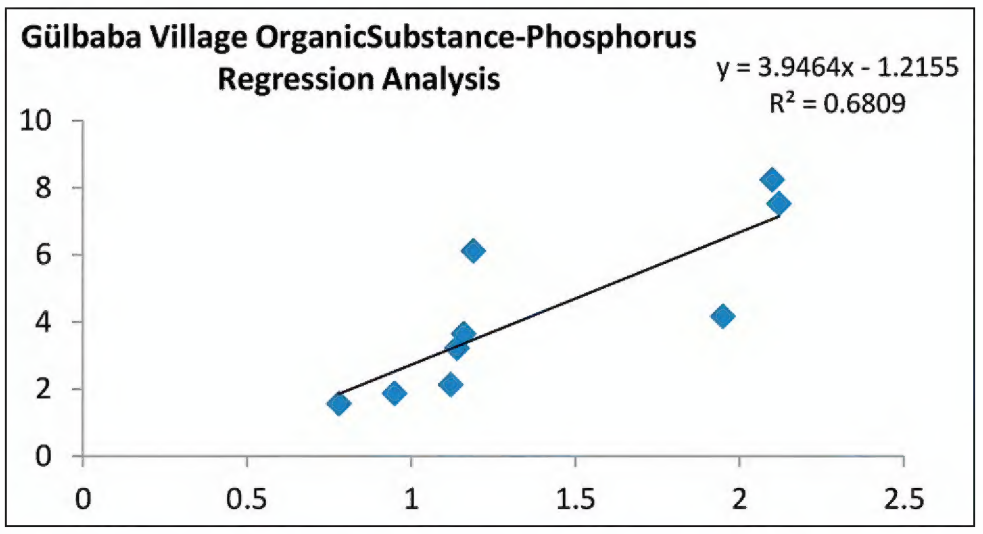

Fig 6. Organic substance-phosphorus regression analysis.

province vineyard soils was included in the excess group within the limit values. Some researchers have reported that it can be considered as sufficient if the variable K content of the soils grown in vines is between 5-10% (Leake, 1999; Lanyon et al., 2004). When the vineyard soils in the study were evaluated on average, the statistical differences were found at the level of $p<0.01$. Hisar village vineyard lands gave the highest value with an average of 113.99kg/da. Looking at the general average values, the Kilis province vineyard soils examined in this study were classified as soils with high potassium content, with a potassium level of 83.92 kg/da (Table 4).

CONCLUSION

In this study, physical and chemical analyses were performed on soil samples taken from the vineyards of Kilis province, where the production of the "Horoz Karası" grape variety was intensively carried out. The general condition and fertility level of the soils were evaluated. It was determined that the pH value of the examined vineyard soils is slightly alkaline, with a clay loam texture, moderately salty, and containing a lot of lime. Furthermore, it was observed that the amount of organic matter was low, and the phosphorus content was low and insufficient, while the potassium content was high. The amount of organic matter in the soil, which affects productivity and quality, was found to be insufficient in our vineyard soils, and it was also observed that it was below the recommended levels with its variable P content. According to the soil analyses results, it can be concluded that the nutrients needed should be provided to the soil when needed by our farmers, who continue to produce with traditional methods and with ancestral practices without using fertilization in the "Horoz Karası" grape variety vineyards, which are at a level to compete with the world in terms of quality characteristics. However, with conscious fertilization, the sustainability of production can be ensured in the vineyard soils. For these reasons, an annual fertilization program should be applied to obtain

quality and abundant products in the vineyard soils of the Kilis province.

In our province, where production is made in dry conditions, base fertilizers containing K and P should be applied to the vineyards before winter precipitation in autumn, and plant growth should be supported with nitrogen fertilizers in early spring. Organic fertilization should also be included in order to ensure sustainable soil fertility and increase the organic matter content. In addition, green manuring applications containing leguminous plants are recommended. It is recommended that grape producers have soil analyzes and nutrients that are missing in their soil should be given to the soil by fertilization.

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Conflicts of Interest

No conflict of interest is declared.

Authors' contributions

The authors declared that they have contributed equally to this article.

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